

## SEQUENCE LISTING

IAP20 Ref ID: A11111 13 DEC 2005

<110> The Scripps Research Institute  
Deiters, Alexander  
Cropp, T Ashton  
Chin, Jason W  
Anderson, J Christopher  
Schultz, Peter G

<120> UNNATURAL REACTIVE AMINO ACID GENETIC CODE ADDITIONS

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<170> PatentIn version 3.3

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 aacaaagaag cgggtaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
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<210> 14  
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 <212> DNA  
 <213> artificial

<220>  
 <223> artificial synthetase

<400> 14  
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 gttccattgt tatgcctgaa acgcttcag caggcgggcc acaagccggt tgcgctggta 180  
 ggcggcgca cgggtctgat tggcgaccg agcttcaaag ctgccgagcg taagctgaac 240  
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 atgaatgtgc tgaccttcct gcgcgatatt ggcaaact tctccgttaa ccagatgac 420  
 aacaaagaag cgggtaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
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<210> 15

<211> 540  
 <212> DNA  
 <213> artificial

<220>  
 <223> artificial synthetase

<400> 15  
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 gttccattgt tatgcctgaa acgcttccag caggcggggc acaagccggt tgcgctggta 180  
 ggcggcgcgga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240  
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 gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360  
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 aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
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<210> 16  
 <211> 540  
 <212> DNA  
 <213> artificial

<220>  
 <223> artificial synthetase

<400> 16  
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 gttccattgt tatgcctgaa acgcttccag caggcggggc acaagccggt tgcgctggta 180  
 ggcggcgcgga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240  
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 gatttcgact gtggagaaaa ctctgctatc gcggccaatt gttatgactg gttcggcaat 360  
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 aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
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<210> 17  
 <211> 624  
 <212> DNA  
 <213> artificial

<220>  
 <223> artificial synthetase

<400> 17  
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ggcggcgcg cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240
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cgtcgtctgc atcagaatca ggtg 624

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<210> 18  
 <211> 609  
 <212> DNA  
 <213> artificial

<220>  
 <223> artificial synthetase

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ctgaaadgct tccagcaggc gggccacaag ccggttgccg tggtaggcgg cgcgacgggt 180
ctgattggcg acccgagctt caaagctgcc gagcgtaagc tgaacaccga agaaactggt 240
caggagtggg tggacaaaat ccgtaagcag gttgccccgt tcttcgattt cgactgtgga 300
gaaaactctg ctatcgcggc caataattat gactggttcg gcaatatgaa tgtgctgacc 360
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aagcagcgtc tcaaccgtga agatcagggg atttcgttca ctgagttttc ctacaacctg 480
ctgcaggggt atggttttgc ctgtttgaac aaacagtacg gtgtgggtgct gcaaattggg 540
ggttctgacc agtggggtaa catcacttct ggtatcgacc tgacctgctg tctgcatcag 600
aatcaggtg 609

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<210> 19  
 <211> 591  
 <212> DNA  
 <213> artificial

<220>  
 <223> artificial synthetase

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<400> 19
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 ttcaaagctg ccgagcgtaa gctgaacacc gaagaaactg ttcaggagtg ggtggacaaa 240  
 atccgtaagc aggttgcccc gttcctcgat ttcgactgtg gagaaaactc tgctatcgcg 300  
 gccataaatt atgactgggt cggcaatatg aatgtgctga ccttcctgcg cgatattggc 360  
 aaacacttct ccgttaacca gatgatcaac aaagaagcgg ttaagcagcg tctcaaccgt 420  
 gaagatcagg ggatttcggt cactgagttt tcctacaacc tgctgcaggg ttatggttat 480  
 gcctgtatga acaaacagta cgggtgtggt ctgcaaattg gtggttctga ccagtggggg 540  
 aacatcactt ctggtatcga cctgaccctg cgtctgcacg agaatcaggt g 591

<210> 20

<211> 621

<212> DNA

<213> artificial

<220>

<223> artificial synthetase

<220>

<221> misc\_feature

<222> (26)..(26)

<223> n is a, c, g, or t

<220>

<221> misc\_feature

<222> (612)..(612)

<223> n is a, c, g, or t

<220>

<221> misc\_feature

<222> (618)..(618)

<223> n is a, c, g, or t

<400> 20

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 ccattgttat gcctgaaacg cttccagcag gcggggccaca agccggttgc gctggtaggc 180  
 ggcgcgacgg gtctgattgg cgacccgagc ttcaaagctg ccgagcgtaa gctgaacacc 240  
 gaagaaactg ttcaggagtg ggtggacaaa atccgtaagc aggttgcccc gttcctcgat 300  
 ttcgactgtg gagaaaactc tgctatcgcg gccataaatt atgactgggt cggcaatatg 360  
 aatgtgctga ccttcctgcg cgatattggc aaacacttct ccgttaacca gatgatcaac 420  
 aaagaagcgg ttaagcagcg tctcaaccgt gaagatcagg ggatttcggt cactgagttt 480  
 tcctacaacc tgctgcaggg ttattctatg gcctgtgcga acaaacagta cgggtgtggtg 540  
 ctgcaaattg gtggttctga ccagtggggg aacatcactt ctggtatcga cctgaccctg 600  
 cgtctgcacg anaatcangt g 621

<210> 21  
<211> 588  
<212> DNA  
<213> artificial

<220>  
<223> artificial synthetase

<400> 21  
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ggccacaagc cggttgcgct ggtaggcggc gcgacgggtc tgattggcga cccgagcttc 180  
aaagctgccg agcgtaagct gaacaccgaa gaaactgttc aggagtgggt ggacaaaatc 240  
cgtaagcagg ttgccccgtt cctcgatttc gactgtggag aaaactctgc tatcgcggcc 300  
aataattatg actggttcgg caatatgaat gtgctgacct tctgcgcgga tattggcaaa 360  
cacttctccg ttaaccagat gatcaacaaa gaagcgggta agcagcgtct caaccgtgaa 420  
gatcagggga ttctggtcac tgagttttcc tacaacctgc tgcagggtta ttctgcggcc 480  
tgtgcgaaca aacagtacgg tgtggtgctg caaattggtg gttctgacca gtggggtaac 540  
atcacttctg gtatcgacct gaccgcgtct ctgcatcaga atcagggtg 588

<210> 22  
<211> 600  
<212> DNA  
<213> artificial

<220>  
<223> artificial synthetase

<220>  
<221> misc\_feature  
<222> (403)..(403)  
<223> n is a, c, g, or t

<220>  
<221> misc\_feature  
<222> (513)..(513)  
<223> n is a, c, g, or t

<220>  
<221> misc\_feature  
<222> (515)..(515)  
<223> n is a, c, g, or t

<220>  
<221> misc\_feature  
<222> (518)..(518)  
<223> n is a, c, g, or t

<220>  
<221> misc\_feature  
<222> (531)..(531)  
<223> n is a, c, g, or t

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ttccagcagg cggggccaca gccggttgcg ctggtaggcg gcgcgacggg tctgattggc 180  
gacccgagct tcaaagctgc cgagcgtaag ctgaacaccg aagaaactgt tcaggagtgg 240  
gtggacaaaa tccgtaagca ggttgccccg ttctctgatt tcgactgtgg agaaaactct 300  
gctatcgcg ccaataatta tgactgggtc ggcaatatga atgtgctgac cttcctgcgc 360  
gatattggca aacacttctc cgtaaccag atgatcaaca aanaagcggg taagcagcgt 420  
ctcaaccgtg aagatcaggg gatttcgttc actgagtttt cctacaacct gctgcagggt 480  
tattcggctg cctgtgcgaa caaacagtac ggngngngnc tgcaaattgg nggttctgac 540  
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<210> 23  
<211> 591  
<212> DNA  
<213> artificial

<220>  
<223> artificial synthetase

<220>  
<221> misc\_feature  
<222> (588)..(588)  
<223> n is a, c, g, or t

<400> 23  
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gcggggccaca agccggttgc gctggtaggc ggcgcgacgg gtctgattgg cgacccgagc 180  
ttcaaagctg ccgagcgtaa gctgaacacc gaagaaactg ttcaggagtg ggtggacaaa 240  
atccgtaagc aggttgcccc gttcctcgat ttcgactgtg gagaaaactc tgctatcgcg 300  
gccataatt atgactggtt cggcaatatg aatgtgctga cttcctgcgc cgatattggc 360  
aaacacttct ccgtaacca gatgatcaac aaagaagcgg ttaagcagcg tctcaaccgt 420  
gaagatcagg ggatttcgtt cactgagttt tctacaacc tgctgcaggg ttatagtgcg 480  
gcctgtgta acaaacagta cgggtgtggt ctgcaaattg gtggttctga ccagtggggg 540  
aacatcactt ctggtatcga cctgaccgcg cgtctgcac agaatcangt g 591

<210> 24  
<211> 600  
<212> DNA  
<213> artificial

<220>

<223> artificial synthetase

<400> 24

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ttccagcagg cgggccacaa gccggttgcg ctggtaggcg gcgcgacggg tctgattggc    180
gacccgagct tcaaagctgc cgagcgtaag ctgaacaccg aagaaactgt tcaggagtgg    240
gtggacaaaa tccgtaagca ggttgccccg ttcctcgatt tcgactgtgg agaaaactct    300
gctatcgcg ccaatgatta tgactggctt ggcaatatga atgtgctgac cttcctgcgc    360
gatattggca aacacttctc cgtaaccag atgatcaaca aagaagcggg taagcagcgt    420
ctcaaccgtg aagatcaggg gatttcgttc actgagtttt cctacaacct gctgcagggg    480
tataattttg cctgtgtgaa caaacagtac ggtgtggtgc tgcaaattgg tggttctgac    540
cagtggggta acatcacttc tggtatcgac ctgaccgcgc gtctgcatca gaatcaggtg    600
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<210> 25

<211> 579

<212> DNA

<213> artificial

<220>

<223> artificial synthetase

<400> 25

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ccggttgcg tggtaggcgg cgcgacgggt ctgattggcg acccgagctt caaagctgcc    180
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gactggctcg gcaatatgaa tgtgctgacc ttcctgcgcg atattggcaa acacttctcc    360
gttaaccaga tgatcaacaa agaagcgggt aagcagcgtc tcaaccgtga agatcagggg    420
atttcgttca ctgagttttc ctacaatctg ctgcaggggt attcggctgc ctgtcttaac    480
aaacagtacg gtgtggtgct gcaaattggg ggttctgacc agtggggtaa catcacttct    540
ggtatcgacc tgaccgcgc tctgcatcag aatcaggtg      579
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<210> 26

<211> 624

<212> DNA

<213> artificial

<220>

<223> artificial synthetase

<220>

<221> misc\_feature



<222> (13)..(13)  
<223> n is a, c, g, or t

<220>  
<221> misc\_feature  
<222> (599)..(599)  
<223> n is a, c, g, or t

<400> 26  
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gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180  
ggcggcgcgga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240  
accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcagggttg cccgttcctc 300  
gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360  
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aacaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
ttttcctaca acctgctgca gggttattct atggcctgtt tgaacaaaca gtacggtgtg 540  
gtgctgcaaa ttggtgggtc tgaccagtgg ggtaacatca cttctggtat cgacctganc 600  
cgctgtctgc atcagaatca ggtg 624

<210> 27  
<211> 625  
<212> DNA  
<213> artificial

<220>  
<223> artificial synthetase

<220>  
<221> misc\_feature  
<222> (600)..(600)  
<223> n is a, c, g, or t

<400> 27  
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gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180  
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accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcagggttg cccgttcctc 300  
gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360  
atgaatgtgc tgaccttcct gcgcgatatt ggcaaact tctccgttaa ccagatgatc 420  
aacaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
ttttcctaca atctgctgca gggttattcg gctgcctgtc ttaacaaaca gtacggtgtg 540

gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgaacctgan 600  
 ccgtcgtctg catcaaaatc aagtg 625

<210> 28  
 <211> 624  
 <212> DNA  
 <213> artificial

<220>  
 <223> artificial synthetase

<400> 28  
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 gttccattgt tatgcctgaa acgcttccag caggcaggcc acaagccggt tgcgctggta 180  
 ggcggcgca cgggtctgat tggcgaccg agcttcaaag ctgccgagcg taagctgaac 240  
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 gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360  
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 aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
 ttttcctaca acctgctgca gggttatacg atggcctgtg tgaacaaaca gtacggtgtg 540  
 gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600  
 cgtcgtctgc atcagaatca ggtg 624

<210> 29  
 <211> 624  
 <212> DNA  
 <213> artificial

<220>  
 <223> artificial synthetase

<400> 29  
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 gttccattgt tatgcctgaa acgcttccag caggcgggccc acaagccggt tgcgctggta 180  
 ggcggcgca cgggtctgat tggcgaccg agcttcaagg ctgccgagcg taagctgaac 240  
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 aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
 ttttcctaca acctgctgca gggttattct tatgcctgtc ttaacaaaca gtacggtgtg 540  
 gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600

cgtcgtctgc atcagaatca ggtg

624

&lt;210&gt; 30

&lt;211&gt; 624

&lt;212&gt; DNA

&lt;213&gt; artificial

&lt;220&gt;

&lt;223&gt; artificial synthetase

&lt;400&gt; 30

cgggggctgg tagcccaggt gacggacgag gaagcgtag cagagcgact ggcgcaaggc 60

ccgatcgac tcgctgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttcag caggcgggcc acaagccggt tgcgctggta 180

ggcggcgca cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360

atgaatgtgc tgaccttcct gcgcgatatt ggcaaact tctccgtaa ccagatgac 420

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gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600

cgtcgtctgc atcagaatca ggtg 624

&lt;210&gt; 31

&lt;211&gt; 624

&lt;212&gt; DNA

&lt;213&gt; artificial

&lt;220&gt;

&lt;223&gt; artificial synthetase

&lt;400&gt; 31

cgggggctgg taccccaagt gacggacgag gaagcgtag cagagcgact ggcgcaaggc 60

ccgatcgac tcacgtgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttcag caggcgggcc acaagccggt tgcgctggta 180

ggcggcgca cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360

atgaatgtgc tgaccttcct gcgcgatatt ggcaaact tctccgtaa ccagatgac 420

aacaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcgtgag 480

ttttcctaca acctgctgca gggttatacg tttgcctgta tgaacaaaca gtacggtgtg 540

gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600

cgtcgtctgc atcagaatca ggtg

624

&lt;210&gt; 32

&lt;211&gt; 606

&lt;212&gt; DNA

&lt;213&gt; artificial

&lt;220&gt;

&lt;223&gt; artificial synthetase

&lt;400&gt; 32

gtgacggacg aggaagcgtt agcagagcga ctggcgcaag gcccgatcgc actcacgtgt 60

ggcttcgata ctaccgctga cagcttgcatt ttggggcatt ttgttccatt gttatgcctg 120

aaacgcttcc agcaggcggg ccacaagccg gttgcgctgg taggcggcgc gacgggtctg 180

attggcgacc cgagcttcaa agctgccgag cgtaagctga acaccgaaga aactgttcag 240

gagtgggtgg acaaaatccg taagcagggt gcccgcttcc tcgatttcga ctgtggagaa 300

aactctgcta tcgcggccaa taattatgac tggttcggca atatgaatgt gctgaccttc 360

ctgcgcgata ttggcaaaca cttctccgtt aaccagatga tcaacaaaga agcgggttaag 420

cagcgtctca accgtgaaga tcaggggatt tcgttctactg agttttccta caatctgctg 480

cagggttatt cggctgcctg tcttaacaaa cagtacggtg tgggtgctgca aattggtggt 540

tctgaccagt ggggtaacat cacttctggt atcgacctga cccgtcgtct gcacagaat 600

caggtg 606

&lt;210&gt; 33

&lt;211&gt; 624

&lt;212&gt; DNA

&lt;213&gt; artificial

&lt;220&gt;

&lt;223&gt; artificial synthetase

&lt;400&gt; 33

cgggggctgg tagcccaggt gacggacgag gaagcgtag cagagcgact ggcgcaaggc 60

ccgatcgac tcgtttgtgg ctccgatact accgctgaca gcttgcattt ggggcatctt 120

gttccattgt tatgcctgaa acgcttccag caggcgggccc acaagccggt tgcgctggta 180

ggcggcgcca cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcagggtgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360

atgaatgtgc tgaccttctt gcgcgatatt ggcaaact tctccgttaa ccagatgatc 420

aacaagaag cgggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480

ttttcctaca acctgctgca ggggtatttcg atggcctgta cgaacaaaca gtacgggtgtg 540

gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600

cgtcgtctgc atcagaatca ggtg 624

<210> 34  
 <211> 624  
 <212> DNA  
 <213> artificial

<220>  
 <223> artificial synthetase

<220>  
 <221> misc\_feature  
 <222> (13)..(13)  
 <223> n is a, c, g, or t

<400> 34  
 cgggggctgg tancccaagt gacggacggg gaagcgtag cagagcgact ggcgcaaggc 60  
 ccgatcgac tcagttgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120  
 gttccattgt tatgcctgaa acgcttccag caggcggggc acaagccggt tgcgctggta 180  
 ggcggcgcgga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240  
 accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300  
 gatctcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360  
 atgaatgtgc tgaccttcct gcgcgatatt ggcaaacact tctccgttaa ccagatgac 420  
 aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
 ttttctaca acctgctgca gggttatagt tttgcctgtc tgaacaaaca gtacggtgtg 540  
 gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600  
 cgtcgtctgc atcagaatca ggtg 624

<210> 35  
 <211> 624  
 <212> DNA  
 <213> artificial

<220>  
 <223> artificial synthetase

<400> 35  
 cgggggctgg tagcccaggt gacggacgag gaagcgtag cagagcgact ggcgcaaggc 60  
 ccgatcgac tcacgtgtgg cttcgatcct accgctgaca gcttgcattt ggggcatctt 120  
 gttccattgt tatgcctgaa acgcttccag caggcggggc acaagccggt tgcgctggta 180  
 ggcggcgcgga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240  
 accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300  
 gatttctgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360  
 atgaatgtgc tgaccttcct gcgcgatatt ggcaaacact tctccgttaa ccagatgac 420  
 aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480

ttttcctaca acctgctgca gggttatacg tttgcctgta ctaacaaaca gtacggtgtg 540  
 gtgctgcaaa ttgggtgggtc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600  
 cgtcgtctgc atcagaatca ggtg 624

<210> 36  
 <211> 424  
 <212> PRT  
 <213> artificial

<220>  
 <223> artificial synthetase

<400> 36

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Tyr Ala Cys Leu Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 37  
 <211> 424  
 <212> PRT  
 <213> artificial

&lt;220&gt;

&lt;223&gt; artificial synthetase

&lt;400&gt; 37

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Ile Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Leu Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240



Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 38

<211> 424

<212> PRT

<213> artificial

<220>

<223> artificial synthetase

<400> 38

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45  
 Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60  
 Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80  
 Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95  
 Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110  
 Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125  
 Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140  
 His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160  
 Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175  
 Leu Leu Gln Gly Tyr Ser Met Ala Cys Ala Asn Lys Gln Tyr Gly Val  
 180 185 190  
 Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205  
 Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220  
 Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240  
 Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255  
 Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270  
 Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
420

<210> 39  
<211> 424  
<212> PRT  
<213> artificial

<220>  
<223> artificial synthetase

<400> 39

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
20 25 30

Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
                   85                                  90                                  95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
                   100                                  105                                  110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
                   115                                  120                                  125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
                   130                                  135                                  140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
                   145                                  150                                  155                                  160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
                                   165                                  170                                  175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Leu Asn Lys Gln Tyr Gly Val  
                                   180                                  185                                  190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
                   195                                  200                                  205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
                   210                                  215                                  220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
                   225                                  230                                  235                                  240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
                                   245                                  250                                  255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
                   260                                  265                                  270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
                   275                                  280                                  285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
                   290                                  295                                  300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
                   305                                  310                                  315                                  320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
                   325                                  330                                  335

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Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 40  
 <211> 424  
 <212> PRT  
 <213> artificial

<220>  
 <223> artificial synthetase

<400> 40

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Thr Met Ala Cys Leu Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
420

<210> 41  
<211> 424  
<212> PRT  
<213> artificial

<220>  
<223> artificial synthetase

<400> 41

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
20 25 30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Thr Tyr Ala Cys Leu Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420



<210> 42  
 <211> 424  
 <212> PRT  
 <213> artificial

<220>  
 <223> artificial synthetase

<400> 42

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Leu Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Ser Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
420

<210> 43  
<211> 424  
<212> PRT  
<213> artificial

<220>  
<223> artificial synthetase

<400> 43

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
20 25 30

Pro Ile Ala Leu Leu Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Ala Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
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Asn Tyr Cys Leu Ile Cys Trp Lys  
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Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
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Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Arg Met Ala Cys Leu Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
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Pro Ile Ala Leu Ile Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
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Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Gly Met Ala Cys Ala Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
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Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
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Asn Tyr Cys Leu Ile Cys Trp Lys  
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Pro Ile Ala Leu Gly Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160



Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Gly Phe Ala Cys Ala Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
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Pro Ile Ala Leu Gly Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Gly Tyr Ala Cys Met Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
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Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
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Asn Tyr Cys Leu Ile Cys Trp Lys  
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Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Leu Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Ala Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
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1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
20 25 30

Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
Page 45

35

40

45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Ala Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
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Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
20 25 30

Pro Ile Ala Leu Leu Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
Page 47

85

90

95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Ala Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350



Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
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Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
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Asn Tyr Cys Leu Ile Cys Trp Lys  
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Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
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Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 Page 49

130

135

140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Val Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
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Asn Tyr Cys Leu Ile Cys Trp Lys  
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Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
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Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Ile Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asp Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Asn Phe Ala Cys Val Asn Lys Gln Tyr Gly Val  
 Page 51

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185

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Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 53  
 <211> 424

&lt;212&gt; PRT

&lt;213&gt; artificial

&lt;220&gt;

&lt;223&gt; artificial synthetase

&lt;400&gt; 53

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Leu Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 Page 53

225                      230                      235                      240  
 Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
                                  245                                   250                                   255  
 Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
                                  260                                   265                                   270  
 Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
                                  275                                   280                                   285  
 Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
                                  290                                   295                                   300  
 Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
                                  305                                   310                                   315                                   320  
 Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
                                  325                                   330                                   335  
 Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
                                  340                                   345                                   350  
 Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
                                  355                                   360                                   365  
 Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
                                  370                                   375                                   380  
 Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
                                  385                                   390                                   395                                   400  
 Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
                                  405                                   410                                   415  
 Asn Tyr Cys Leu Ile Cys Trp Lys  
                                  420

<210> 54  
 <211> 424  
 <212> PRT  
 <213> artificial

<220>  
 <223> artificial synthetase

<400> 54

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1                      5                      10                      15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Gly Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Leu Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu

275

280

285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 55  
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<220>  
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<400> 55

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60



Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Leu Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser

325

330

335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 56  
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 <212> PRT  
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<220>  
 <223> artificial synthetase

<400> 56

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Ser Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Thr Met Ala Cys Val Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 Page 59

370

375

380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 57

<211> 424

<212> PRT

<213> artificial

<220>

<223> artificial synthetase

<400> 57

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Ala Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175  
 Leu Leu Gln Gly Tyr Ser Tyr Ala Cys Leu Asn Lys Gln Tyr Gly Val  
 180 185 190  
 Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205  
 Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220  
 Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240  
 Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255  
 Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270  
 Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285  
 Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300  
 Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320  
 Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335  
 Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350  
 Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365  
 Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380  
 Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400  
 Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys

420

<210> 58  
 <211> 424  
 <212> PRT  
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<220>  
 <223> artificial synthetase

<400> 58

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Ala Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Thr Met Ala Cys Cys Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 59  
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 <212> PRT  
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<220>  
 <223> artificial synthetase

<400> 59

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15  
 Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30  
 Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45  
 Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60  
 Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80  
 Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95  
 Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110  
 Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125  
 Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140  
 His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160  
 Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175  
 Leu Leu Gln Gly Tyr Thr Phe Ala Cys Met Asn Lys Gln Tyr Gly Val  
 180 185 190  
 Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205  
 Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220  
 Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240  
 Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255



Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 60  
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 <212> PRT  
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<220>  
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<400> 60

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Val Ala Cys Leu Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 61

<211> 424

<212> PRT

<213> artificial-

<220>

<223> artificial synthetase

<400> 61

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Thr Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 62  
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<220>  
 <223> artificial synthetase

<400> 62

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Ser Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Phe Ala Cys Leu Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 63

<211> 424

<212> PRT

<213> artificial

<220>

<223> artificial synthetase

<400> 63

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Thr Phe Ala Cys Thr Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205  
 Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220  
 Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240  
 Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255  
 Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270  
 Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285  
 Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300  
 Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320  
 Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335  
 Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350  
 Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365  
 Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380  
 Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400  
 Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415  
 Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

&lt;210&gt; 64

&lt;211&gt; 129

&lt;212&gt; DNA

&lt;213&gt; Escherichia coli



<400> 64  
agcttcccga taagggagca ggccagtaaa aagcattacc ccgtggtggg gttcccgagc 60  
ggccaaaggg agcagactct aaatctgccg tcatcgacct cgaaggttcg aatccttccc 120  
ccaccacca 129

<210> 65  
<211> 129  
<212> RNA  
<213> Escherichia coli

<400> 65  
agcuucccga uaagggagca ggccaguaaa aagcauuacc ccgugguggg guucccgagc 60  
ggccaaaggg agcagacucu aaauucggcg ucaucgaccu cgaagguucg aauccuuccc 120  
ccaccacca 129

<210> 66  
<211> 34  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 66  
atgaagtagc tgtcttctat cgaacaagca tgcg 34

<210> 67  
<211> 34  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 67  
cgaacaagca tgcgattagt gccgacttaa aaag 34

<210> 68  
<211> 33  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 68  
cgctactctc ccaaatagaa aaggtctccg ctg 33

<210> 69  
<211> 32  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 69  
ctggaacagc tatagctact gatttttcct cg 32

<210> 70  
<211> 34  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 70  
gccgtcacag attagttggc ttcagtggag actg 34

<210> 71  
<211> 33  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 71  
gattggcttc ataggagact gatatgctct aac 33

<210> 72  
<211> 33  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 72  
gcctctatag ttgagacagc atagaataat gcg 33

<210> 73  
<211> 35  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 73  
gagacagcat agatagagtg cgacatcatc atcgg 35

<210> 74  
<211> 37  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 74  
gaataagtgc gacatagtca tcggaagaga gtagtag 37

<210> 75  
<211> 35  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 75  
ggcacaagac agttgtaggt atcgattgac tcggc

35

<210> 76  
<211> 34  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 76  
cgctactctc cccaaattta aaaggtctcc gctg

34

<210> 77  
<211> 34  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 77  
cgctactctc cccaaatata aaaggtctcc gctg

34

<210> 78  
<211> 34  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 78  
cgctactctc cccaaatgga aaaggtctcc gctg

34

<210> 79  
<211> 34  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 79  
cgctactctc cccaaagata aaaggtctcc gctg

34

<210> 80  
<211> 34  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 80  
cgctactctc cccaaaaaaa aaaggtctcc gctg 34

<210> 81  
<211> 34  
<212> DNA  
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<220>  
<223> oligonucleotide primer

<400> 81  
gccgtcacag attttttggc ttcagtggag actg 34

<210> 82  
<211> 34  
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<220>  
<223> oligonucleotide primer

<400> 82  
gccgtcacag attatttggc ttcagtggag actg 34

<210> 83  
<211> 34  
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<213> artificial

<220>  
<223> oligonucleotide primer

<400> 83  
gccgtcacag attggttggc ttcagtggag actg 34

<210> 84  
<211> 34  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 84  
gccgtcacag atgatttggc ttcagtggag actg 34

<210> 85  
<211> 34  
<212> DNA  
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<220>  
<223> oligonucleotide primer

<400> 85  
gccgtcacag ataaattggc ttcagtggag actg 34

<210> 86  
 <211> 424  
 <212> PRT  
 <213> artificial

<220>  
 <223> artificial synthetase

<400> 86

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Ile Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Gly Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Gly Met Ala Cys Ala Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr

210

215

220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

&lt;210&gt; 87

&lt;211&gt; 6

&lt;212&gt; PRT

&lt;213&gt; artificial

&lt;220&gt;

&lt;223&gt; tryptic peptide including unnatural amino acids

&lt;220&gt;

<221> MISC\_FEATURE

<222> (2)..(2)

<223> X is an unnatural amino acid (p-acetyl-L-phenylalanine, p-benzoyl-L-phenylalanine, p-azido-L-phenylalanine, O-methyl-L-tyrosine, or p-iodo-L-phenylalanine) or tryptophan, tyrosine, or leucine

<400> 87

Val Xaa Gly Ser Ile Lys

1

5

<210> 88

<211> 11

<212> DNA

<213> artificial

<220>

<223> B box

<220>

<221> misc\_feature

<222> (8)..(8)

<223> n is a, c, g, or t

<400> 88

ggttcgantic c

11

<210> 89

<211> 82

<212> DNA

<213> artificial

<220>

<223> oligonucleotide primer

<400> 89

gggggggaccg gtgggggggac cggtaaagctt cccgataagg gagcaggcca gtaaaaagca 60

ttaccccgtg gtgggttccc ga 82

<210> 90

<211> 90

<212> DNA

<213> artificial

<220>

<223> oligonucleotide primer

<400> 90

ggcggcgcta gcaagcttcc cgataaggga gcaggccagt aaaaaggga gttcaggac 60

ttttgaaaaa aatggtggtg ggggaaggat 90

<210> 91

<211> 68

<212> DNA

<213> artificial

<220>

<223> oligonucleotide primer

<220>

<221> misc\_feature

<222> (1)..(1)

<223> n=I

<220>

<221> misc\_feature

<222> (14)..(14)

<223> n=I

<400> 91

nggggggacc ggtngggggg accggtcggg atcgaagaaa tgatggtaaa tgaaatagga 60

aatcaagg 68

<210> 92

<211> 62

<212> DNA

<213> artificial

<220>

<223> oligonucleotide primer

<400> 92

gggggggaat tcagttgatt gtatgcttgg tatagcttga aatattgtgc agaaaaagaa 60

ac 62

<210> 93

<211> 86

<212> DNA

<213> artificial

<220>

<223> oligonucleotide primer

<400> 93

tcataacgag aattcgggga tcgaagaaat gatggtaaata gaaataggaa atctcataac 60

gagaattcat ggcaagcagt aacttg 86

<210> 94

<211> 72

<212> DNA

<213> artificial

<220>

<223> oligonucleotide primer

<400> 94

ttactacgtg cggccgcatg gcaagcagta acttggttact acgtgcggcc gcttatttcc 60

agcaaatacag ac 72

<210> 95

<211> 28

<212> DNA

<213> artificial



<220>  
<223> oligonucleotide primer

<400> 95  
ccgatcgcgc tcgcttgcg cttcgatc

28

<210> 96  
<211> 27  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 96  
atcgcggcga acgcctatga ctggttc

27

<210> 97  
<211> 40  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 97  
gttgccagggt tatgccgccg cctgtgcgaa caaacagtac

40

<210> 98  
<211> 26  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 98  
gccgctttgc tatcaagtat aaatag

26

<210> 99  
<211> 21  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 99  
caagccgaca accttgattg g

21

<210> 100  
<211> 60  
<212> DNA  
<213> artificial

<220>  
<223> oligonucleotide primer

<400> 100

ggggacaagt ttgtacaaaa aagcaggcta cgccaatttt aatcaaagtg ggaatattgc 60

<210> 101

<211> 60

<212> DNA

<213> artificial

<220>

<223> oligonucleotide primer

<400> 101

ggggacaagt ttgtacaaaa aagcaggcta ggccaatttt aatcaaagtg ggaatattgc 60

<210> 102

<211> 58

<212> DNA

<213> artificial

<220>

<223> oligonucleotide primer

<400> 102

ggggaccact ttgtacaaga aagctggggtt actctttttt tgggtttggt ggggtatc 58

<210> 103

<211> 22

<212> DNA

<213> artificial

<220>

<223> oligonucleotide primer

<400> 103

aagctatacc aagcatacaa tc 22

<210> 104

<211> 49

<212> DNA

<213> artificial

<220>

<223> oligonucleotide primer

<400> 104

acaaggcctt gctagcttac tctttttttg gggttggtgg ggtatcttc 49